

Two New Species of Poecilostomatoid Copepoda associated with Razor Clams (*Bivalvia*, *Solenidae*) in the Yellow Sea

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황해의 맛조개류(이매패류)에 공생하는 요각류 2신종

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적 요

황해에서 서식하는 이매패류 *Solen grandis* Dunker(죽합)의 체내에 사는 *Anthessius* 속 그리고 *Solen stricitus* Gould(맛조개)의 체내에 사는 *Herrmannella* 속의 요각류 2 신종을 각각 *A. projectus* 및 *H. exigua*로 명명하여 기재한다.

Key words: Poecilostomatoid Copepoda, New species, *Anthessius*, *Herrmannella*, Yellow Sea, Korea.

INTRODUCTION

Most species of *Anthessius* Della Valle, 1880 and almost all species of *Herrmannella* Canu, 1891 have been found associated with the mollusks. They comprise five species occurring in Korean seas: two species of *Anthessius* and three species of *Herrmannella*. These are *Anthessius atrinae* described by Suh and Choe (1991), *A. longipedis* described by Ho and Kim (1992), *Herrmannella*

*이 연구는 과학재단 연구비 지원(관리번호 921-0400-008-2)에 의한 결과의 일부임.

soleni described by Kim and Ho (1991), *H. longicaudata* Avdeev, 1975 (Ho and Kim, 1992), and *H. hoonsooi* described by Kim (1992).

The bivalve mollusks of the genus *Solen* are rather common mud-dwellers in the Yellow Sea. From a representative of this genus (*S. grandis* Dunker) in this sea, Kim and Ho (1991) reported two species, *Herrmannella soleni* and *Leptinogaster digita*, as new. Recently the author examined further bivalves of this species and the other form, *Solen strictus* Gould those had been collected formerly in the Yellow Sea. He found unexpectedly two unrecorded species of copepod associates, one species belonging to *Anthessius* from *Solen grandis* and another species belonging to *Herrmannella* from *Solen strictus*. Both species are to be described herein as new.

The examined specimens were dissected and measured after soaking in lactic acid. All figures were drawn with the aid of a camera lucida.

DESCRIPTIONS

Family Anthessidae

***Anthessius projectus*, n. sp. (Figs. 1-3)**

Type specimens. Ovigerous female holotype, male allotype and paratypes (12 females and 20 males) from washings of a razor clam *Solen grandis* Dunker, from Simpo, Kimje-kun (approximately 35°50' N, 126°43' E) in the Yellow Sea, on 16 August 1991, collected by I.-H. Kim. Holotype, allotype, and undissected paratypes (10 females and 20 males) will be deposited in the U.S. National Museum, Smithsonian Institution. Dissected other paratypes are kept in the collections of the author.

Female. Body (Fig. 1A) 1.52 mm (1.40-1.56 mm) long, excluding setae on caudal rami, with maximum width of 0.59 mm, based on 5 specimens. Prosoma 0.94 mm long, 1.59 times longer than wide, and slightly produced anteriorly. Cephalosome and first pedigerous somite discernible from each other. Fourth pedigerous somite 341 μ m wide, characteristically with projection on each side of posterior margin of tergite (Fig. 1B). Urosome 5-segmented. Fifth pedigerous somite (=first urosomal somite) 201 μ m wide. Genital complex 183 \times 167 μ m, or 1.10 times longer than wide, gradually narrowed in area posterior to genital areas, with distinct anterolateral expansions; maximum width measured across area of anterior 27 % of length. First two abdominal somites 77 \times 93 μ m, and 68 \times 82 μ m, respectively. Genital complex and first 2 abdominal somites with crenulate membrane along posteroventral margin. Anal somite 67 \times 75 μ m, with 4-6, large denticles on each side of proximoventral area (Fig. 1C), and extremely minute spinules on posteroventral border. Caudal ramus 87 \times 35 μ m, or 2.49 times longer than wide; posterior margin oblique, with several spinules; outer lateral seta naked, located at midlength of ramus; outermost terminal seta specialized as in Fig. 1C; other 3 terminal setae plumose; dorsal seta shortest and naked. Egg sac oval, 647 \times 271 μ m, and slightly longer than urosome.

Rostum nearly conical, not extending beyond base of antennule. Antennule (Fig. 1E) 7-segmented, 442 μ m long, with armature formula: 4, 15, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete; second segment relatively thick and short; fifth segment long and thin; length of each segment measured along dorsal margin: 57 μ m, 67 μ m, 34 μ m, 86 μ m, 125 μ m, 35 μ m, and 38

μm , respectively, from first to last segments. Antenna (Fig. 1F) 3-segmented; first 2 segments each with 1 inner distal seta; terminal segment broadened distally, more than twice as long as wide, with 2 groups of setules on outer side, 4 inner setae, 1 lateral seta, and distally 3 strong claws and 3 setae.

Labrum (Fig. 1G) with each lobe of characteristically notched on posterior margin. Mandible (Fig. 2A) with 1 bifurcate, membranous lamella between apical lash and setiform element; first 2 teeth on apical lash distinctly larger. Maxillule (Fig. 2B) with 2 very long and 2 small setae; inner distal corner with 1 pointed, membranous process. Maxilla (Fig. 2C) 2-segmented; first segment unornamented; second segment terminated in long process, with 5 or 6 teeth on posterior margin, several setules on anterior margin, 1 minute proximal setule, and 2 extremely unequal, perpendicularly crossed, medial setae. Maxilliped (Fig. 2D) indistinctly 2-segmented, and terminated in 2 small processes.

Leg 1 (Fig. 2E), leg 2 (Fig. 2F), leg 3, and leg 4 (Fig. 2G) with 3-segmented rami. First exopodal segment of leg 1 with 3-4 large, pointed denticles on outer margin. All legs with hairs on inner posterior margin. Third endopodal segment of legs 3 and 4 armed with bifurcate, spiniform projection near inner distal corner. Armature formula of legs 1-4 as follows (Roman numerals indicates spine, and Arabic ones, setae):

Leg 1: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 4
enp. 0-1; 0-1; I, 5

Leg 2: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 5
enp. 0-1; 0-2; III, 3

Leg 3: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 5
enp. 0-1; 0-2; IV, 2

Leg 4: Coxa 0-1; basis 1-0; exp. I-0; I-1; II, I, 5
enp. 0-1; 0-2; IV, 1

Leg 5 (Fig. 2H) nearly oval, $130 \times 87 \mu\text{m}$, or 1.49 times longer than wide, with numerous spinules on both margins, and distally 3 spines and 1 small seta; outer spine $78 \mu\text{m}$; median spine $70 \mu\text{m}$; inner spine longest, $85 \mu\text{m}$; seta $31 \mu\text{m}$. Leg 6 represented by 2 small setules in genital area.

Male. Body (Fig. 3A) slenderer than that of female, 1.39 mm long, with maximum width of 0.44 mm. Prosoma $81 \mu\text{m}$ long, with its frontal area distinctly projected. Ratio of length to width of prosoma 1.84:1. Fourth pedigerous somite without projections on posterior margin of tergite. Urosome (Fig. 3B) 6-segmented. Fifth pedigerous somite $148 \mu\text{m}$ wide. Genital somite $160 \times 160 \mu\text{m}$ (ratio 1:1). First to fourth abdominal somites measured, $82 \times 95 \mu\text{m}$, $73 \times 83 \mu\text{m}$, $53 \times 73 \mu\text{m}$, and $60 \times 65 \mu\text{m}$, respectively. Caudal ramus $80 \times 31 \mu\text{m}$, or 2.58 times as long as wide.

Rostrum as in female. Antennule with 4 more aesthetes than that of female: 3 on second and 1 on fourth segments, as indicated by dark circles on Fig. 1E. Antenna with moderately enlarged seta on first segment (Fig. 3C).

Labrum, mandible, maxillule, and maxilla as in female. Maxilliped (Fig. 3D) large, and 4-segmented including terminal claw; First segment with spinules distally; second segment with scattered spinules on basal half of inner side, 2 setae and 3 or 4 longitudinal rows of spinules along inner margin; third segment small and unarmed; fourth segment with 1 long and 1 small setae, and terminated in long, arched claw.

Distal seta of third endopodal segment of leg 1 modified to spiniform element (Fig. 3E). Other

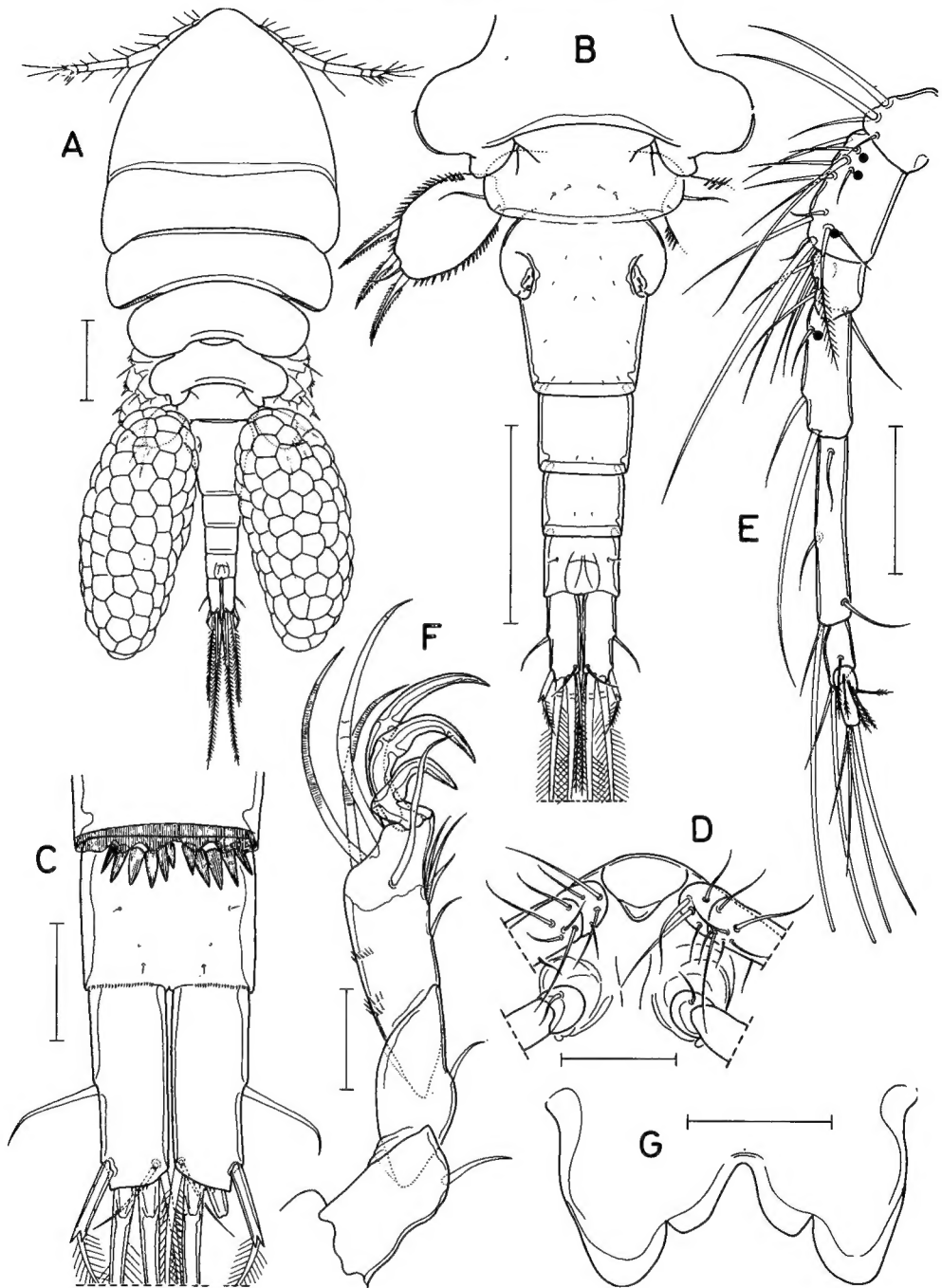


Fig. 1. *Anthessius projectus*, n. sp., female: A, habitus, dorsal; B, fourth pedigerous somite and urosome, dorsal; C, anal somite and caudal rami, ventral; D, rostral area; E, antennule (dark circles represent the places of added aesthetascer in male); F, antenna; G, labrum. Scales: A, B = 0.2 mm; C, F, G = 0.05 mm; D, E = 0.1 mm.

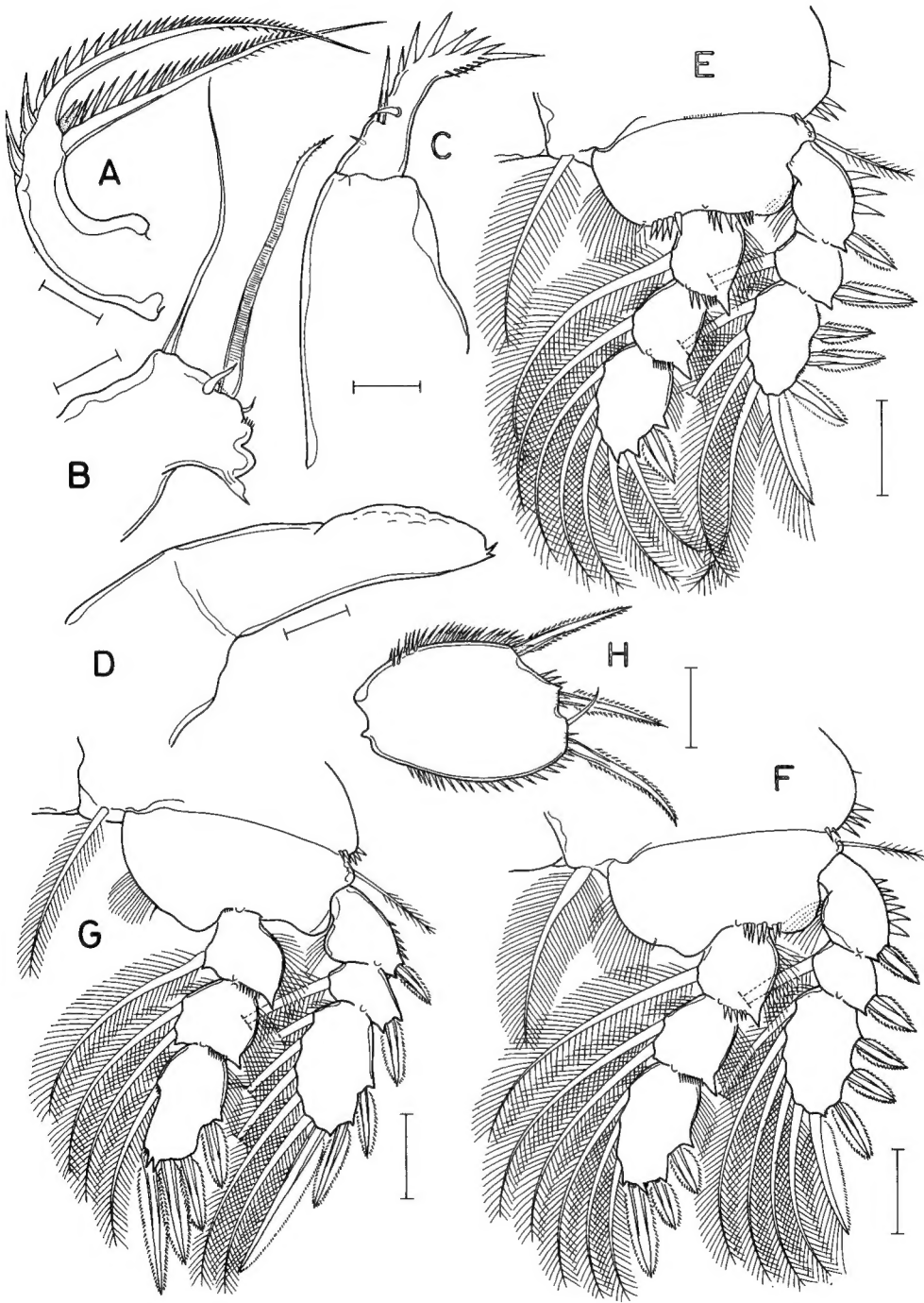


Fig. 2. *Anthessius projectus*, n. sp., female: A, mandible; B, maxillule; C, maxilla; D, maxilliped; E, leg 1; F, leg 2; G, leg 4; H, leg 5. Scales: A-D = 0.02 mm; E-H = 0.05 mm.

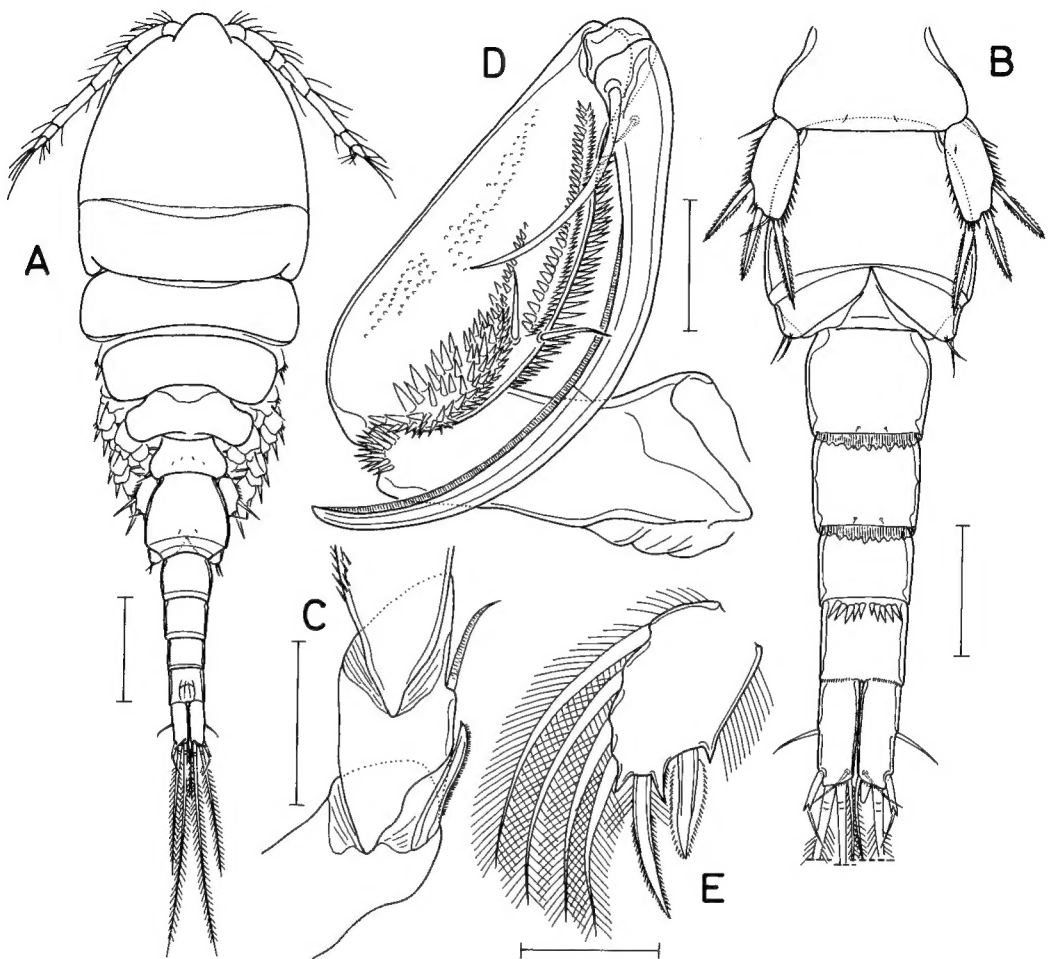


Fig. 3. *Anthessius projectus*, n. sp., male: A, habitus, dorsal; B, urosome, ventral; C, basal part of antenna; D, maxilliped; E, third endopodal segment of leg 1. Scales: A = 0.2 mm; B = 0.1 mm; C-E = 0.05 mm.

parts of leg 1 and morphologies of legs 2-4 as in female. Leg 5 slenderer than that of female, $79 \times 39 \mu\text{m}$ (ratio 2.0:1). Leg 6 represented by 2 setae and 1 tiny denticle on posterior corner of each genital flap.

Etymology. The specific name, *projectus*, is derived from the projections of posterior tergal margin of the fourth pedigerous somite, which is thought to be the most prominent peculiarity of the new species.

Remarks. The diagnostic characters of *Anthessius projectus*, n. sp., can be summarized as follows: 1) Anal somite is armed with 4-6 prominent denticles on each side of proximoventral area; 2) the caudal ramus is 2.49 times as long as wide; 3) the number of terminal claws of antenna is 3; 4) the armature formula of the third endopodal segment of leg 4 is II,I,5; 5) leg 5 is 1.49 times as long as wide, with spinules on both margins; 6) the lobes of labrum are notched on posterior margin; and 7) the tergite of the fourth pedigerous somite has two lobate projections posteriorly. The last one seems the most diagnostic feature of the new species (hence the specific name), which is easily observable

without dissection.

The genus *Anthessius* comprises 38 described species, of which 15 species have the armature formula of the third endopodal segment of leg 4 being II, I, 5, as in the new species, and in other species it is III, I, 5. These fifteen species are separable by the number of terminal claws on antenna, and only two species, *Anthessius atrinae* Suh and Choe, 1991 and *A. dilatatus* (Sars, 1918), have three terminal claw on antenna, although in the latter species the outer claw is setiform. The new species easily can be separated from *A. atrinae* by the smaller body (about 2.5 mm in *A. atrinae*), the broader caudal rami (ratio 5.6:1 in *A. atrinae*), and by the shape of leg 5 (distally broadened, with short spines in *A. atrinae*), and from *A. dilatatus* by the broader caudal rami, the slender antenna, and the broader leg 5 (slender, both margins parallel in *A. dilatatus*).

Family Sabelliphilidae

***Herrmannella exigua*, n. sp. (Figs. 1-3)**

Type specimens. Holotype female, allotype male, and paratypes (15 females 10 males), from *Solen strictus* Gould collected in the Yellow Sea coast, near Puan (approximately 35°47' N, 126°39' E), on 16 August 1991 by I.-H. Kim. Holotype, allotype and undissected paratypes 12 females and 8 males) will be deposited in the U.S. National Museum of Natural History, Smithsonian Institution.

Female. Body (Fig. 1A) 1.00 mm (0.94-1.04 mm) long (excluding rostrum and setae on caudal rami), based on 10 specimens. Maximum width 0.32 mm. Prosoma 5-segmented, occupying 49% of whole body length, with its ratio of length to width 1.53:1. Fourth pedigerous somite 129 μ m wide, with conical epimeral areas. Urosome (Fig. 1B) 5-segmented. First urosomal somite (= fifth pedigerous somite) 96 μ m wide. Genital complex 144 \times 97 μ m, or 1.48 times longer than wide, roundly expanded anteriorly; greatest width measured across anterior one-third; genital area large, and located dorsolaterally in area just anterior to midlength of complex; each area with 1 spinule and 1 seta; ventrodistal margin fringed with weakly crenulate membrane. Three postgenital somites subequal in size, 63 \times 48 μ m, 63 \times 42 μ m, and 60 \times 38 μ m, respectively. First and second abdominal somites with weakly crenulate membrane along ventrodistal margin. Anal somite unornamented. Caudal ramus elongated, 94 \times 14.5 μ m, or 6.48 times longer than wide; outer lateral seta located at midlength of caudal ramus; all setae naked; posterodistal margin of caudal ramus unornamented. Egg sac 404 \times 115 μ m, or 3.5 times longer than wide, almost reaching tip of caudal rami. Each egg about 80 μ m in diameter.

Rostum 52 μ m wide, with long posterior beak reaching posterior margin of first segment of antenna (Fig. 1C). Antennule (Fig. 1D) 7-segmented, about 200 μ m long, with armature formula: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Antenna (Fig. 1E) 4-segmented, with armature formula: 1, 1, 3, and 5 + 1 claw; second segment 2.8 times longer than wide, with minute spinules along outer margin; third segment very short; one seta on third segment and distal 3 setae on terminal segment characteristically bifurcated at tip.

Labrum (Fig. 1F) being 2 widely divergent, unornamented lobes. Mandible (Fig. 1G) slender. Paragnath (Fig. 1H) being small, hairy lobe. Maxillule (Fig. 1I) with 2 setae of unequal length. Maxilla (Fig. 2A) with unarmed first segment; second segment with 1 posterior seta, 1 distal barbed seta, and

terminated in long distal lash with long spines along one side. Maxilliped (Fig. 2B) small and indistinctly 3-segmented; first segment thick; second segment with 2 identical setae; third segment weakly demarcated from second segment, and terminated in 1 pointed element.

Leg 1 (Fig. 2C), leg 2 (Fig. 2D), leg 3, and leg 4 (Fig. 2F) with 3-segmented rami. Leg 1 armed with spinules on distal margin of basis, near proximal area of endopod. Leg 3 identical to leg 2, except for armature formula of third endopodal segment. Leg 4 with 2 spiniform processes on outer margin of third endopodal segment near proximal spine; inner one of 2 terminal spines on this segment about 1.3 times longer than outer one. Armature formula of legs 1-4 as follows (Roman numerals indicating spines, and Arabic ones, setae):

P1: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 4
enp. 0-1; 0-1; I, 5

P2: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 5
enp. 0-1; 0-2; III, 3

P3: Coxa 0-1; basis 1-0; exp. I-0; I-1; III, I, 5
enp. 0-1; 0-2; III, 2

P4: Coxa 0-1; basis 1-0; exp. I-0; I-1; II, I, 5
enp. 0-1; 0-1; II

Leg 5 (Fig. 2G) $45 \times 13 \mu\text{m}$ (ratio 3.50: 1), with weak proximal expansion, 2 naked setae ($43 \mu\text{m}$ and $37 \mu\text{m}$, respectively) and 2 or 3 anterodistal spinules.

Male. Body (Fig. 3A) similar to that of female, but 11-segmented. Body length 0.81 mm. Maximum width 0.25 mm. Urosome (Fig. 3B) 6-segmented. Fifth pedigerous segment $60 \mu\text{m}$ wide. Genital somite $117 \times 98 \mu\text{m}$, or 1.19:1, gradually broader posteriorly; each genital flap armed with 2 setae and 1 row of minute spinules (Fig. 3C). Postgenital somites $40 \times 52 \mu\text{m}$, $50 \times 41 \mu\text{m}$, $48 \times 35 \mu\text{m}$, and $43 \times 31 \mu\text{m}$, respectively. Caudal ramus $77 \times 13 \mu\text{m}$ (ratio 5.9:1).

Rostrum as in female. Antennule resembling that of female, except for addition of 3 aesthetes (2 on second, and 1 on fourth segment) as indicated in Fig. 1D. Antenna (Fig. 3D) similar to that of female but added by minute spinules on inner margin of second segment and 1 more seta on inner distal corner of third segment.

Labrum, mandible, paragnath, maxillule, and maxilla as in female. Maxilliped (Fig. 3E) 4-segmented; first segment armed with 1 thick, spiniform process distally; second segment with 2 setae and many scattered spinules on inner side; third segment shortest, unarmed; fourth segment being long claw, as long as other 3 segments combined, with 1 long proximal seta.

Leg 1 (Fig. 3F) with hairs on inner distal margin of basis, instead of spinules in female; second endopodal segment with stronger outer distal process. Legs 2-4 as in female. Leg 5 (Fig. 3G) $23 \times 7 \mu\text{m}$ (ratio 3.3:1), gradually broader distally, without proximal expansion; two distal setae $34 \mu\text{m}$ and $27 \mu\text{m}$, respectively.

Etymology. The specific name, *exigua*, is derived from *exiguus* (meaning "small" in Latin), alluding the small size of body of the new species.

Remarks. At a first glance, the author thought the examined specimens of *Herrmannella exigua*, n. sp. to be *H. soleni* Kim and Ho, 1991 which was described also from a bivalve of *Solen* in the Yellow Sea. After careful observation, he found that the specimens were composed of two different

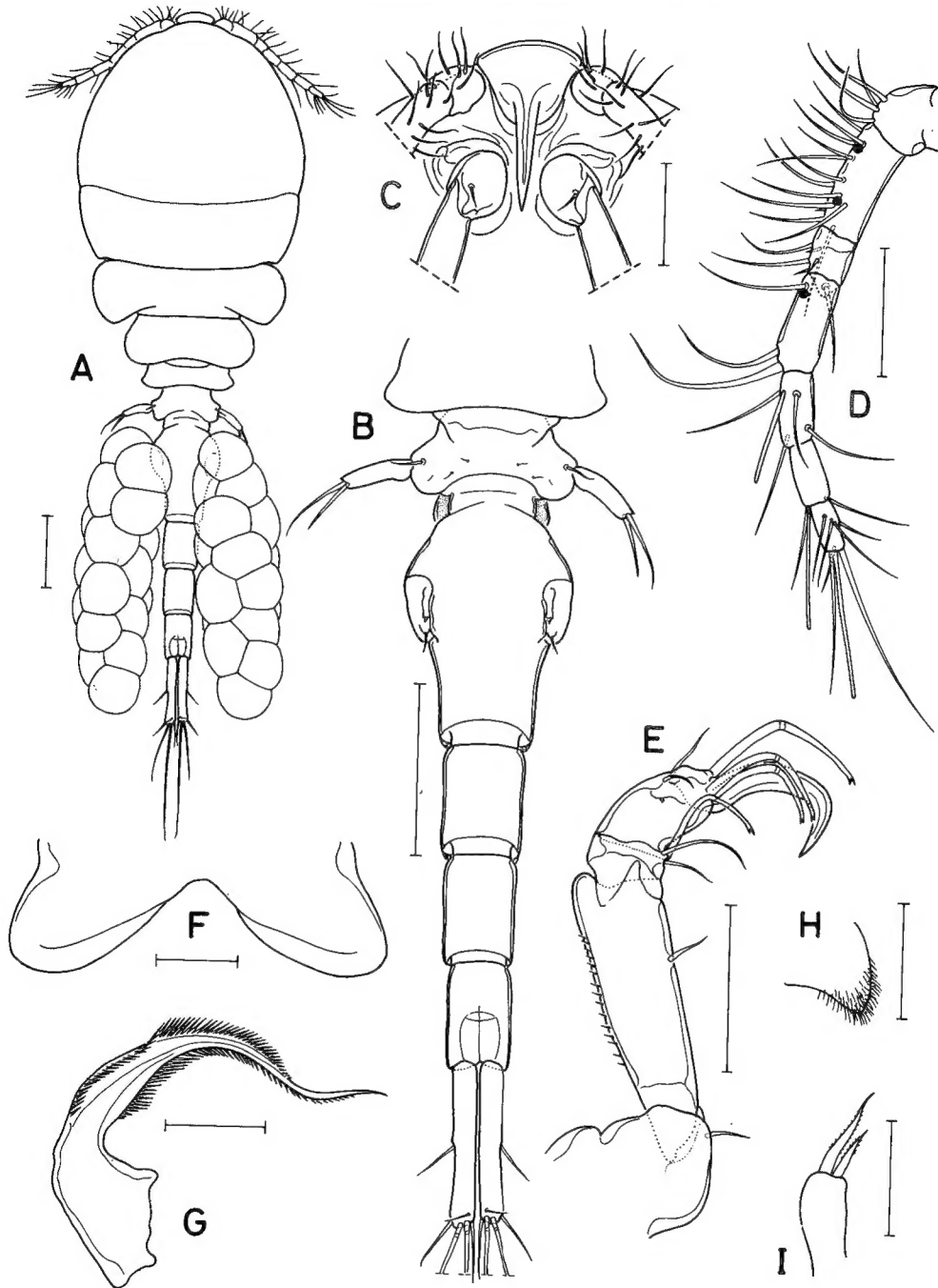


Fig. 4. *Herrmannella exigua*, n. sp., female: A, habitus, dorsal; B, urosome, dorsal; C, rostral area; D, antennule (dark circles represent the places of added aesthetes in male); E, antenna; F, labrum; G, mandible; H, paragnath; I, maxillule. Scales: A, B = 0.1 mm; C-E = 0.05 mm; F-I = 0.02 mm.

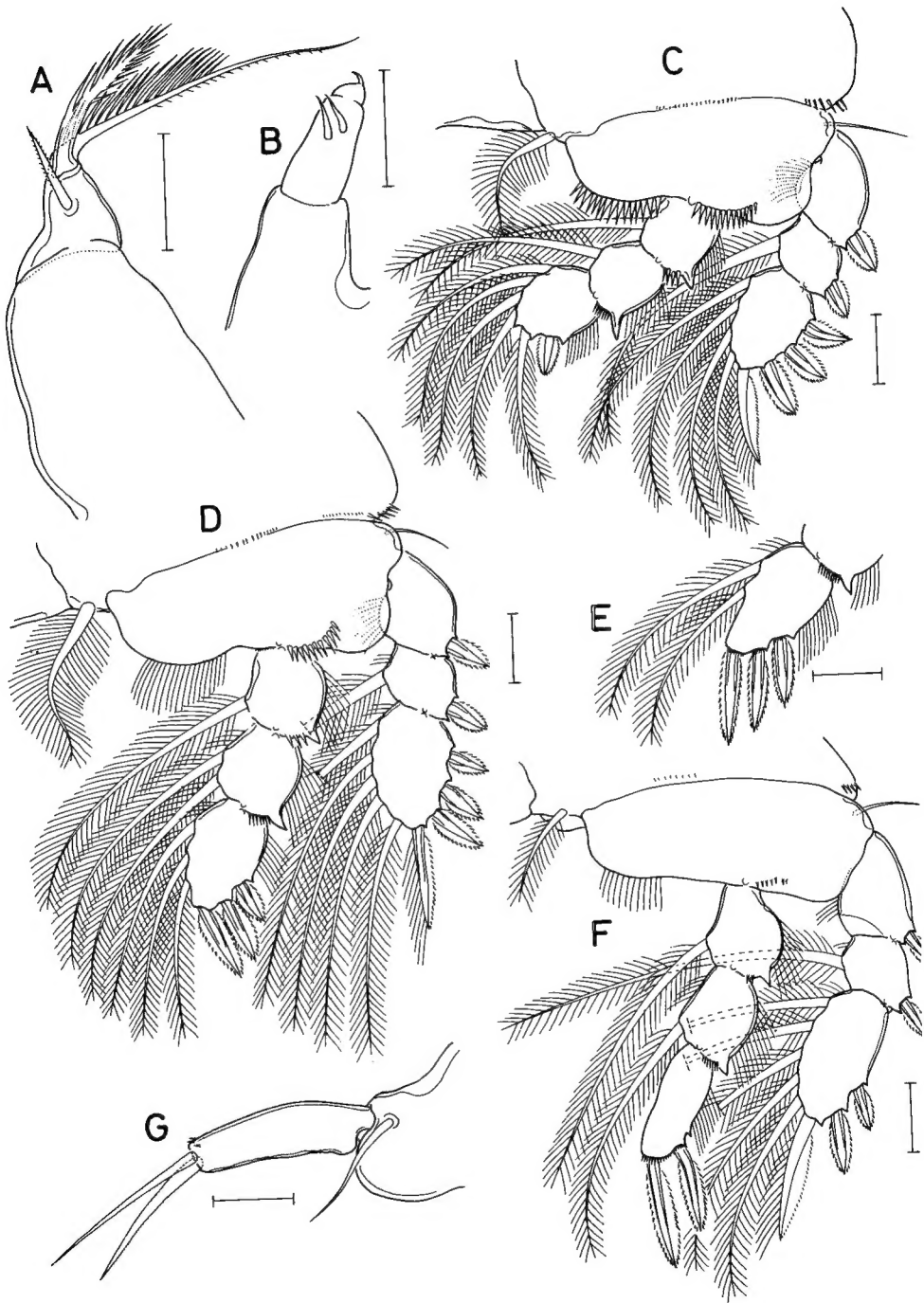


Fig. 5. *Herrmannella exigua*, n. sp., female: A, maxilla; B, maxilliped; C, leg 1; D, leg 2; E, third endopodal segment of leg 3; F, leg 4; G, leg 4. Scales: 0.02 mm in all.

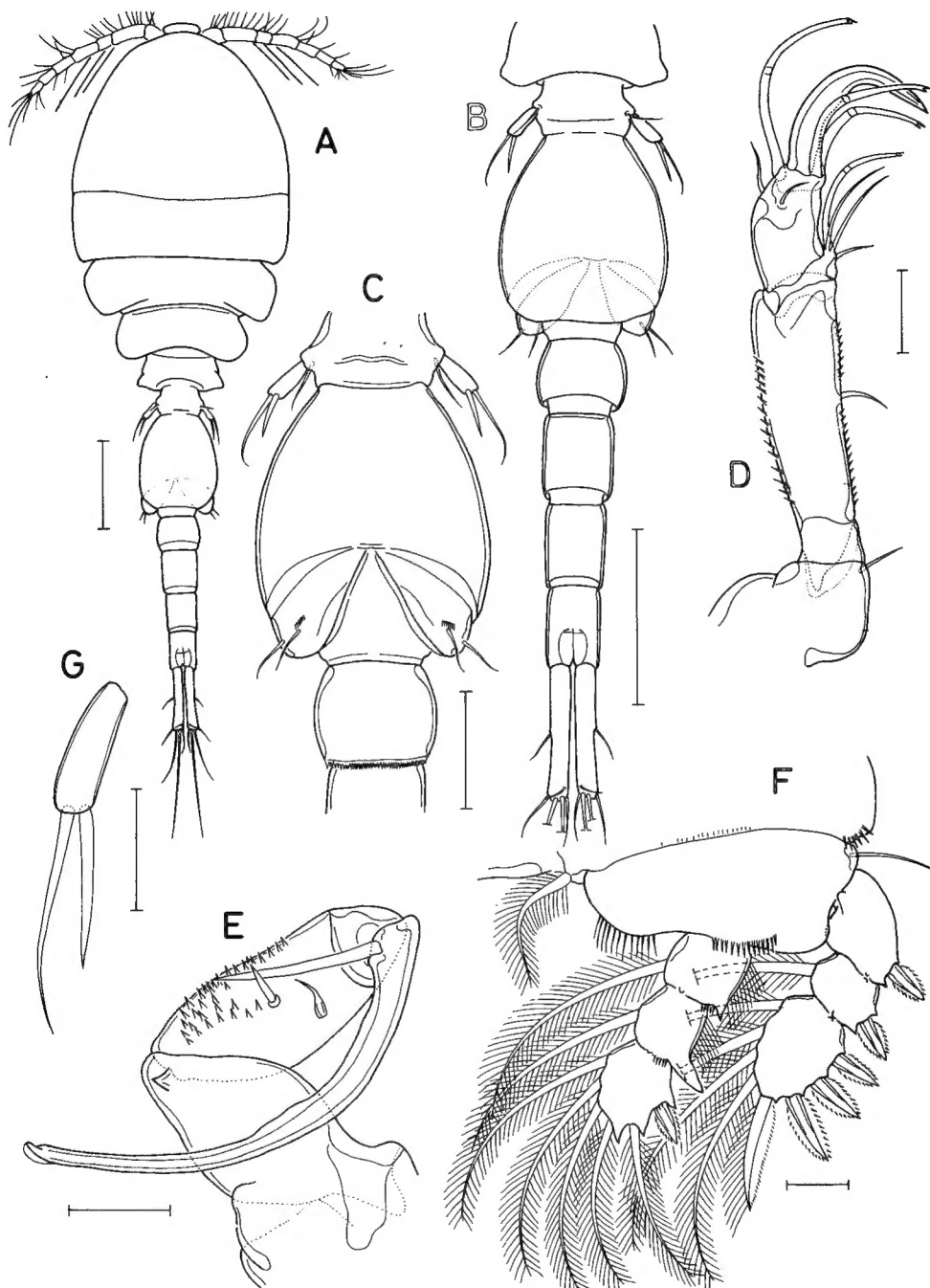


Fig. 6. *Herrmannella exigua*, n. sp., male: A, habitus, dorsal; B, urosome, dorsal; C, frontal part of urosome, ventral; D, antenna; E, maxilliped; F, leg 1. Scales: A, b= 0.1 mm; C= 0.05 mm; D-G= 0.02 mm.

forms which could be sorted by the shape of leg 5 without dissection. These were few specimens of real *H. soleni* and a number of *H. exigua*. In the description of *H. soleni*, Kim and Ho (1991) characterized it by six diagnostic characters, and five of which are shared with *H. exigua*. These

characters are: Small body (about 1.0 mm in length); pointed beak-bearing rostrum; long caudal rami (ratio more than 5); slender antenna; bearing 2 lateral spiniform processes on the terminal segment of leg 4 endopod. In these respects, *H. soleni* seems to be the closest relative of *H. exigua* among other 23 known species of *Herrmannella*, including recently described *H. hoonsooi* Kim, 1992 (Kim, 1992). The remaining one character, regarding to the shape of female leg 5, is distinctly different between the two species. Based on the original description and the observation of the specimens collected together with the type specimens, *H. soleni* has short and bullate leg 5 (measured newly by $33 \times 21 \mu\text{m}$), whereas *H. exigua* has long and slender leg 5 ($43 \times 13 \mu\text{m}$) bearing only weak proximal expansion. Other noticeable features of the new species different from *H. soleni* are the slenderer female genital somite in which the ratio of length to width being 1.48:1 (1.15 in *H. soleni*), the slenderer caudal rami having the ratio 6.48 (about 5.3 in *H. soleni*), the conical epimera of fourth pedigerous somite (rounded in *H. soleni*), and the absence of a large process on second segment of male maxilliped (present in *H. soleni*).

ABSTRACT

Two new species of poecilostomatoid copepod associates, each belonging to the genera *Anthessius* and *Herrmannella*, taken from the razor clams of the genus *Solen*, are described from the Yellow Sea coast.

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RECEIVED: 19 August 1993

ACCEPTED: 20 October 1993